callous necromancer who has cut himself off from communion with his fellows, and has thereby lost the throbbing and compassionate heart of a full life; he is a Faust who has not yet made a bargain with Mephistopheles, and is therefore without human interest. Scientific and humanistic studies are, indeed, supposed to be antipathetic and to represent opposing qualities; so that it has become common to associate science with all that is cold and mechanistic in our being, and to believe that the development of the more spiritual parts of man's nature belongs essentially to other departments of intellectual activity.

When scientific work is undertaken solely with the object of commercial gain, its correlative is selfishness; when it is confined to the path of narrow specialisation, it leads to arrogance; and when its purpose is materialistic domination, without regard to the nobler deeds of humanity, it is a social danger and may become an excuse for learned barbarity. But research is rarely inspired by these motives, nor does devotion to it necessarily inhibit interest in other notes with which a well-balanced mind should be in resonance. Direct contact with Nature and inquiry into her laws do, however, produce a habit of mind which cannot be acquired in literary fields, and they are associated with a wide outlook on life more often than is popularly supposed. Science is not only able to increase the comforts of life and add to material welfare, but also to inspire the highest ethical thought and action; and a prominent place should be given to it in all stages of educational work as much on account of its ennobling influence as because it is a creator of riches.

Success in science means the birth of new knowledge. Patient observation and productive thinking are what the world needs for progress, and what true scientific study demands. There are now so many opportunities of obtaining ready-made opinions that the habits of independent thought, caution in accepting assertion, and critical inquiry into evidence, are suffering atrophy by disuse. *Vox populi, vox Dei*, may be a sound democratic principle for political platforms, but it stands for nothing in science. The men who have advanced the human race throughout the ages are they who have stood for individuality as against the voice of the crowd. We need such leaders now, men who will guide the people instead of waiting for a mandate from them before embarking upon any enterprise; and we need, above all, that the chief officials of departments of State should have had a training in scientific methods before being entrusted with the control of national affairs. While indifference to these things is the distinguishing characteristic of our statesmen and administrative officers, it is useless to expect that the nation's business will be conducted efficiently or its scientific forces be organised on the large scale which modern conditions demand.

ANALYTICAL CONTROL OF MODERN DYES.

The Analysis of Dyestuffs and their Identification in Dyed and Coloured Materials, Lake Pigments, Foodstuffs, etc. By Prof. A. G. Green. Pp. ix + 144. (London: C. Griffin and Co., Ltd., 1915.) Price 8*s*. 6*d*. net.

MODERN developments in the manufacture of synthetic colouring matters have now rendered it possible for the dyer to obtain any desired shade of colour in many different ways, but the suitability of the colour to the conditions under which the dyed material is to be employed depends entirely on the blend of dyes selected. It is evident that some analytical control is desirable in order that the most favourable result can be guaranteed.

Largely owing to the labours, extending over many years, of the author and his collaborators, a method has now been devised which is sufficiently comprehensive and elastic to cope not only with all the known dyes, but also with mixtures of these substances.

The three introductory chapters of this work treat of the chemistry of colouring matters and of the classification of these materials according to their chemical and tinctorial properties. In regard to theories of the colour of organic dyes, Prof. Green seems still to be a faithful adherent of the "quinonoid" hypothesis, in spite of the fact that he has himself discovered at least one dyestuff, namely, primuline (p. 21), to which he has not ascribed a "quinonoid" chemical constitution. It should, however, be added that the practical scheme of analysis presented in this manual is based on the tinctorial properties of the dyes, and not on hypothetical views in regard to their chemical structure. An interesting table serves as the summary of these introductory chapters, in which the chief series of colouring matters are doubly classified in accordance with their chemical nature and their dyeing properties. This tabulation indicates in a striking manner the lines along which future research may lead to many still missing groups of dyes.

The analysis of the dyes in bulk leads to a division into four main classes, in which solubility in water, affinity for unmordanted cotton, and precipitation by tannin form the distinctive

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properties. Further subdivision is effected by successive experiments on the reduction of the dyes and the oxidisability of their reduction products. Owing to recent intense activity in the manufacture of synthetic dyes, each subdivision nowadays contains apparently many members, but, on the other hand, many of the names under which dyes appear are only synonyms employed by different firms.

Although it is sometimes practically impossible to identify the specific dyes on any fabric, yet the author's scheme of analysis enables the analyst to refer these substances to their appropriate classes, after which complete identification may be achieved by comparative dye-tests with standard dyes of known constitution.

After a reference to the detection of artificial dyestuffs in articles of food, the scheme for identifying colouring matters on animal fibres is elaborated. The dyed fabric is subjected to "stripping tests," and also to the action of a reducing agent—in this instance, sodium formaldehyde-sulphoxylate (Rongalite). Separate tests are described for indigoid dyes and for mordants, and a few principles are laid down for the examination of woollen fabrics dyed with mixtures of dyes. In such cases, fractional reduction and "stripping" tests are useful, together with fractional separation by means of solvents.

The problem presented by dyed vegetable fibres is much more complicated than that arising from dyed wool. Many basic dyes, which, when applied to wool, are readily reduced by sodium hydrosulphite, are scarcely attacked by this reagent when they are fixed on tannin-mordanted cotton. Accordingly, the tannin mordant must first be removed by boiling the fabric with caustic soda solution saturated with sodium chloride, the latter compound being added to avoid stripping off the dye.

Certain azo-colours, especially the insoluble "ingrain" azo-derivatives formed on the fibre, offer considerable resistance to the reducing action of ordinary hydrosulphite, and are decolorised very slowly and imperfectly. To overcome this difficulty the reducing agent is rendered more active by the addition of a very small quantity of reducible compound or colouring matter. The most convenient catalyst or sensitiser for this purpose is anthraquinone, a small quantity of which is added to the sodium formaldehyde-sulphoxylate solution.

Indigo is still the premier blue dye, and on account of its high price and valuable tinctorial properties, the estimation of pure indigotin either in bulk or on the fibre is a matter of considerable commercial importance. Special attention may be directed to the method for estimating quantitatively the indigotin on animal fibres worked out by the author in collaboration with Gardner, Lloyd, and Frank, since this process affords an accurate means of detecting the great abuses obtaining in the prevalent practice of "topping" or "bottoming" indigo-dyed materials with other inferior colouring matters.

The identification of organic colouring matters, when carried out in the systematic manner advocated by the author, becomes an important branch of analytical chemistry, so that this handbook may be recommended not only to the makers and users of dyes, but also to all students of organic chemistry. The educational value of the treatise is well exemplified in the chapter on the determination of the constitution of azo-dyes, for the methods adopted would go far towards enabling the analyst to identify any one of the very large number of azo-colouring matters at present on the market.

An index of the principal colouring matters shows the position of these dyes in the analytical separations, which are arranged in twenty-six tables.

The present condition of military warfare existing between the principal industrial nations will, in all probability, be succeeded by a period of strenuous industrial competition between the belligerents. During this period the discoverers of new dyes will, for obvious reasons, no longer, as hitherto, endeavour to protect their discoveries by patents, but will rely rather on keeping secret the methods of manufacture and the chemical nature of the products. At this stage the analytical methods systematised by the author will acquire additional importance in their application to the investigation of new dyes of undisclosed constitution. G. T. M.

RUDIMENTARY SCIENCE FOR COAL-MINERS.

An Introduction to Mining Science. A Theoretical and Practical Text-book for Mining Students. By J. B. Coppock and G. A. Lodge. Pp. x+230. (London: Longmans, Green and Co., 1915.) Price 2*s.* net.

THE object of this little book is to put before the young coal-miner a certain number of facts in elementary science, mainly chemistry and physics, in such a way as to impress them upon him more readily than can be done through the medium of ordinary text-books upon these sciences. Such subjects as combustion, flame, explosion, the atmosphere, mine gases, coal, etc., are treated, each in a short chapter, which commences with a few ele-

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